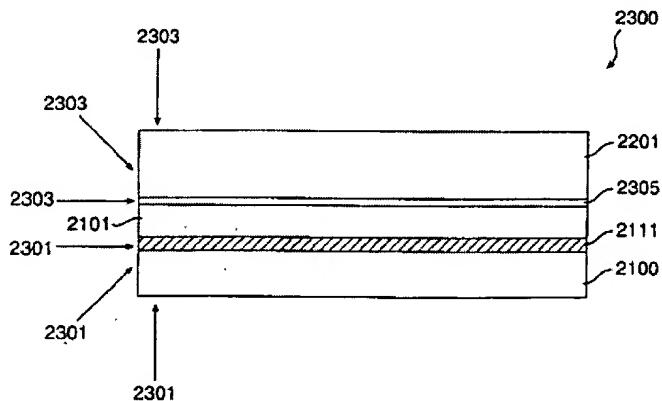


REMARKS/ARGUMENTS

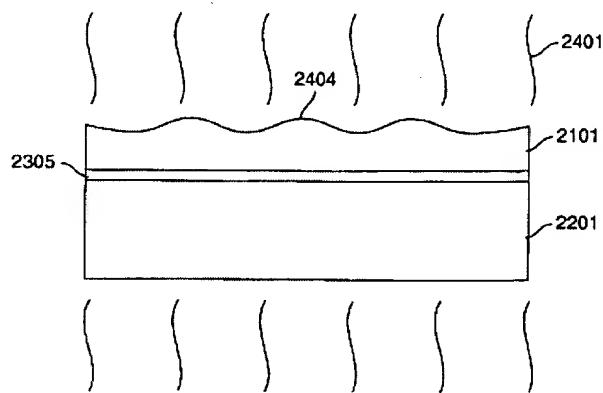
Claim 42 is amended by this response. Claims 29-45 remain pending.

Embodiments in accordance with the present invention relate to methods for reducing surface roughness of cleaved films. For example, an embodiment of the present invention shown and described in connection with Figure 3 (reproduced below), describes forming a silicon-on-insulator (SOI), wherein two wafers are bonded together and then cleaved apart in a different location:



After bonding the wafers into a sandwiched structure 2300, as shown in FIG. 3, the method includes a controlled cleaving action to remove the substrate material to provide a thin film of substrate material 2101 overlying an insulator 2305 the target silicon wafer 2201. The controlled-cleaving occurs by way of selective energy placement or positioning or targeting 2301, 2303 of energy sources onto the donor and/or target wafers. (Page 8, lines 1-6)

As illustrated in Figure 4 (reproduced below):



the detached surface of the film of silicon material 2101 is often rough and needs finishing:

to smooth or treat surface 2404, the substrate is subjected to thermal treatment 2401 in a hydrogen bearing environment. Additionally, the substrate is also subjected to an etchant including a halogen bearing compound such as HCl, HBr, HI, HF, and others. (Emphasis added; page 11, lines 4-8).

As a result of this treatment, roughness may be reduced by at least about eighty percent. (See page 3, lines 12-14, Abstract, and Figures 6-7).

Thus in accordance with embodiments of the present invention, the cleaved surface (of silicon material 2101 of Figures 3 and 4) is subjected to the following processes at the same time: (1) thermal treatment; and (2) etching, thereby reducing roughness by at least about eighty percent. Pending independent claims 29 and 41 recite such embodiments:

29. A dry method for finishing SOI substrates, said method comprising:  
providing an SOI substrate comprising a cleaved surface, said cleaved surface having a first surface roughness value;  
performing a hydrogen treatment to increase a concentration of hydrogen of said cleaved surface; and  
performing an etchant and thermal treatment after the hydrogen treatment, the etchant and thermal treatment comprising:

\_\_\_\_\_ increasing a temperature of an environment associated with said cleaved surface to greater than about 1,000° Celsius; and

\_\_\_\_\_ contacting said cleaved surface with a hydrogen bearing environment at least when said temperature of said environment is greater than about 1,000° Celsius to reduce said first surface roughness value by at least about eighty percent to a second surface roughness value, said hydrogen bearing environment including at least an HCl gas and a hydrogen gas;

whereupon the cleaved surface having the second roughness value is substantially planarized. (Emphasis added)

42. A dry method for finishing SOI wafers, said method comprising:  
providing an SOI wafer comprising a main surface that has been cleaved, said cleaved main surface having a first surface roughness value;  
performing a hydrogen treatment to increase a hydrogen concentration of said cleaved main surface; and  
performing an etchant and thermal treatment after the hydrogen treatment, the etchant and thermal treatment comprising:  
\_\_\_\_\_ increasing a temperature of an environment associated with said cleaved main surface to greater than about 1,000° Celsius; and

\_\_\_\_\_ contacting said cleaved main surface with a hydrogen bearing environment at least when said temperature of said environment is greater than about 1,000° Celsius to reduce said first surface roughness value by at least about eighty percent to a second surface roughness value, said hydrogen bearing environment including at least an HCl gas and a hydrogen gas;

wherein the main surface is substantially planarized in its entirety to the second roughness value, the planarized main surface providing a surface whereon a plurality of devices are later defined. (Emphasis added)

#### **Rejection of Claims Under 35 U.S.C. § 112**

Claims 41 and 42 have been rejected under 35 U.S.C. § 112, first paragraph. In response, claim 42 has now been amended to indicate definition of devices after planarization of the main surface.

Regarding claim 41, this claim recites that devices "are fabricated on said planarized main surface", and that this main surface is planarized by the increased temperature and contacting steps. Accordingly, applicants respectfully assert that claim 41 inherently indicates that devices are formed after the increased temperature step.

#### **Rejection of Claims Under 35 U.S.C. § 103(a)**

The pending claims have also been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,251,754 to Ohshima et al. ("the Ohshima patent"), in combination with other references. These claim rejections are overcome as follows.

As a threshold matter, the Examiner is further reminded that in order to establish a *prima facie* case of obviousness, "the prior art reference (or references when combined) must teach or suggest all the claim limitations." MPEP 2142. Here, even when combined, the references relied upon by the Examiner fail to teach, or even suggest, reducing roughness in a cleaved surface by at least about eighty percent.

Specifically, the Ohshima patent fails to mention any specific conditions of high temperature annealing of a cleaved surface. In order to provide such a teaching, the Examiner has combined the Ohshima patent with U.S. Patent 5,141,878 to Benton et al. ("the Benton patent").

However, the Benton patent also fails to teach each of the elements of the pending claims. For example, the Benton patent describes reduction of surface roughness through exposure to H<sub>2</sub> and HCl, of a trench feature, which is not the claimed cleaved surface. The Benton patent contains no teaching regarding reducing roughness of a cleaved surface, as is recited by the pending claims. The Benton patent, moreover, contains no teaching or even suggestion to reduce surface roughness by at least about eighty percent, as is also recited by the pending claims.

In recognition of the failure of even the combined Ohshima and Benton patents to teach every element of the pending claims, the Examiner has further combined these references with an article by Moriceau *et al.*, "Hydrogen annealing treatment used to obtain high quality SOI surfaces" ("the Moriceau article").

However, the Examiner is respectfully reminded of a second requirement to establish a *prima facie* case of obviousness: "there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings." Any motivation to combine reference teachings must be found in the prior art, and not be based upon applicant's own disclosure. (MPEP 2143). In the instant case, there is no motivation to combine the references relied upon by the Examiner.

As acknowledged above, the Ohshima patent does describe manufacturing a SOI substrate or wafer. By contrast, the surface treated by the Benton patent is produced by etching a pre-existing substrate, as a preliminary step to the process of epitaxial growth of silicon to form part of a device structure. The reduction of surface roughness of the Benton patent thus occurs at a very different stage in the fabrication of a semiconductor, long after the initial formation of a substrate.

Given that the Benton and Ohshima patents describe surface treatment at such different stages of fabrication of a semiconductor, the Benton patent cannot now be read by the Examiner to suggest combination with the Ohshima patent. Based upon at least this failure to provide motivation to combine the Ohshima and Benton patents, continued rejection of the claims as obvious is improper.

Moreover, the Examiner has also combined the Ohshima and Benton patents with the Moriceau article. Specifically, the Moriceau article relates to treating a surface only with thermal energy and with hydrogen gas. There is no mention in the Moriceau article regarding concurrent etching conditions. Exposing a surface to hydrogen in the absence of etching is a fundamentally different process than that recited by the pending claims, wherein a surface is also exposed to etching conditions.

Of course, there is ample teaching in the instant application regarding such use of etching conditions concurrent with thermal treatment, in order to reduce roughness in a cleaved surface by levels recited in the pending claims. However, the Examiner is reminded that reliance upon Applicants' disclosure to provide motivation is strictly prohibited:

[t]he tendency to resort to "hindsight" based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art. (Emphasis added; MPEP 2142).

This prohibition against the use of hindsight, combined with a lack of any motivation in the Moriceau article for its combination with the other references relied upon by the Examiner, also renders improper any obviousness conclusion.

In summary, because the Examiner must rely upon a combination of references to teach each and every element of the pending claims, and because these references fail to provide motivation for their combination, it is respectfully asserted that the instant claim rejections are improper and should be withdrawn.

Appl. No. 09/893,340  
Response to Office Action Mailed October 26, 2004

PATENT

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is respectfully requested. If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

  
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